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INTEGRATED INFORMATION SUPPORT SYSTEM (IISS)
Volume VIII - User Interface Subsystem
Part 2 - User Interface (UI) Management System Development Specification -- UI Development Specification

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This development specification establishes the development, test and qualification requirements of the User Interface Services (UIS) computer program.

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FOREWORD

This technical report covers work performed under Air Force Contract F33600-87-C-0464, DAPro Project. This contract is sponsored by the Manufacturing Technology Directorate, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Bruce A. Rasmussen, Branch Chief, Integration Technology Division, Manufacturing Technology Directorate, through Mr. David L. Judson, Project Manager. The Prime Contractor was Integration Technology Services, Software Programs Division, of the Control Data Corporation, Dayton, Ohio, under the direction of Mr. W. A. Osborne. The DAPro Project Manager for Control Data Corporation was Mr. Jimmy P. Maxwell.

The DAPro project was created to continue the development, test, and demonstration of the Integrated Information Support System (IISS). The IISS technology work comprises enhancements to IISS software and the establishment and operation of IISS test bed hardware and communications for developers and users.

The following list names the Control Data Corporation subcontractors and their contributing activities:

SUBCONTRACTOR	ROLE
Control Data Corporation	Responsible for the overall Common Data Model design development and implementation, IISS integration and test, and technology transfer of IISS.
D. Appleton Company	Responsible for providing software information services for the Common Data Model and IDEF1X integration methodology.
ONTEK	Responsible for defining and testing a representative integrated system base in Artificial Intelligence techniques to establish fitness for use.
Simpact Corporation	Responsible for Communication development.
Structural Dynamics Research Corporation	Responsible for User Interfaces, Virtual Terminal Interface,and Network Transaction Manager design, development, implementation, and support.
Arizona State University	Responsible for test bed operations and support.

TABLE OF CONTENTS

Page

SECTION 1

SCOPE

1.1 Identification

This specification establishes the development, test and qualification requirements of a collection of applications identified as the User Interface Services, known in this document as the UI Services. The UI Services are one configuration item of the Integrated Information Support System (IISS) User Interface (UI).

Please refer to the Software Availability Bulletin, Volume III, Part 16, CI# SAB620326000, for current IISS software and documentation availability.

1.2 Functional Summary

The User Interface Services are:

- Access Control - restricts access to the IISS system to authorized users.
- Function Invocation - allows an IISS user to invoke application programs and services.
- Exit - disconnects a user from the IISS system.
- Function Screen Help - provides information about the functions available to an IISS user.
- Change Password - allows an IISS user to modify his or her access password.
- System Generation - allows the IISS system manager to maintain the database of authorization information and move it from one computer system to another as required.
- Message Management - allows an application programmer to define symbolic error codes and corresponding messages to be used in an application.

SECTION 2

DOCUMENTS

2.1 Reference Documents

[1] Systran, ICAM Documentation Standards, IDS150120000C, 23 December 1983.

[2] Structural Dynamics Research Corporation, IISS Terminal Operator Guide, OM 620344000, 31 May 1988.

[3] Structural Dynamics Research Corporation, Forms Language Compiler Development Specification, DS 620344401, 31 May 1988.

[4] Structural Dynamics Research Corporation, Forms Driven Form Editor Development Specification, DS 62034402, 31 May 1988.

[5] Structural Dynamics Research Corporation, Report Writer Development Specification, DS 620344100, 31 May 1988.

[6] Structural Dynamics Research Corporation, Rapid Application Generator Development Specification, DS 620344502, 31 May 1988.

[7] Structural Dynamics Research Corporation, Text Editor Development Specification, DS 620344600, 31 May 1988.

[8] Structural Dynamics Research Corporation, Application Interface Development Specification, DS 620344700, 31 May 1988.

[9] Structural Dynamics Research Corporation, User Interface Services Development Specification, DS 6203441002, 31 May 1988.

[10] Structural Dynamics Research Corporation, Form Processor Development Specification, DS 620344200, 31 May 1988.

[11] Structural Dynamics Research Corporation, Virtual Terminal Interface Development Specification, DS 620344300, 31 May 1988.

[12] General Electric Co., System Design Specification, 7 February 1983.

2.2 Terms and Abbreviations

Application Interface: (AI), subset of the IISS User Interface that consists of the callable routines that are linked with applications that use the Form Processor or Virtual Terminal. The AI enables applications to be hosted on computers other than the host of the User Interface.

Application Process: (AP), a cohesive unit of software that can be initiated as a unit to perform some function or functions.

Form: structured view which may be imposed on windows or other forms. A form is composed of fields. These fields may be defined as forms, items, and windows.

Form Definition: (FD), forms definition language after compilation. It is read at runtime by the Form Processor.

Forms Definition Language: (FDL), the language in which electronic forms are defined.

Forms Driven Form Editor: (FDFE), subset of the FE which consists of a forms driven application used to create Form Definition files interactively.

Form Editor: (FE), subset of the IISS User Interface that is used to create definitions of forms. The FE consists of the Forms Driven Form Editor and the Forms Language Compiler.

Forms Language Compiler: (FLAN), subset of the FE that consists of a batch process that accepts a series of forms definition language statements and produces form definition files as output.

Form Processor: (FP), subset of the IISS User Interface that consists of a set of callable execution time routines available to an application program for form processing.

IISS Function Screen: the first screen that is displayed after logon. It allows the user to specify the function he wants to access and the device type and device name on which he is working.

Integrated Information Support System: (IISS), a computing environment used to investigate, demonstrate, test the concepts and produce application for information management and information integration in the context of Aerospace Manufacturing. The IISS addresses the problems of integration of data resident on heterogeneous data bases supported by heterogeneous computers interconnected via a Local Area Network.

Presentation Schema: (PS), may be equivalent to a form. It is the view presented to the user of the application.

User Data: data which is either input by the user or output by the application programs to items.

User Interface: (UI), IISS subsystem that controls the user's terminal and interfaces with the rest of the system. The UI consists of two major subsystems: the User Interface Development System (UIDS) and the User Interface Management System (UIMS).

User Interface Development System: (UIDS), collection of IISS User Interface subsystems that are used by applications programmers as they develop IISS applications. The UIDS includes the Form Editor and the Application Generator.

User Interface Management System: (UIMS), the runtime UI. It consists of the Form Processor, Virtual Terminal, Application Interface, the User Interface Services and the Text Editor.

User Interface Services: (UI Services), subset of the IISS User Interface that consists of a package of routines that aid users in controlling their environment. It includes message management, change password, and application definition services.

User Interface/Virtual Terminal Interface: (UI/VTI), another name for the User Interface.

Virtual Terminal: (VT), subset of the IISS User Interface that performs the interfacing between different terminals and the UI. This is done by defining a specific set of terminal features and protocols which must be supported by the UI software which constitutes the virtual terminal definition. Specific terminals are then mapped against the virtual terminal software by specific software modules written for each type of real terminal supported.

Window: dynamic area of a terminal screen on which predefined forms may be placed at run time.

Window Manager: a facility which allows the following to be manipulated: size and location of windows, the device on which an application is running, the position of a form within a window. It is part of the Form Processor.

SECTION 3

REQUIREMENTS

3.1 Computer Program Definition

The UI Services are a collection of services that provide the following functions:

- Access Control
- Function Invocation
- Exit
- Function Screen Help
- Change Password
- System Generation
- Message Management

These services are implemented as:

- remote applications which are invoked from the IISS Function Screen,
- internal applications which are built into the UI and can only be invoked from the IISS Function Screen, and
- batch applications which are run outside of the IISS environment.

The remote applications are also available as batch applications.

3.1.1 Interface Requirements

Each application interfaces with one or more data files and, if it is a forms-based application, the Form Processor or the Application Interface depending on whether it is an internal, remote, or batch application.

3.1.1.1 Interface Block Diagram

Figure 3-1 is the interface block diagram that illustrates how internal, remote, and batch applications connect with the other elements of the system.

```
  +-----------+      +-----------------------+
  | Terminal  |      | Remote Application    +----------+
  +-----+-----+      +-----------------------+          |
        |            | Application Interface |          |
+-------+-------+    +-----------------------+    +-----+-----+
| Device Driver |    |     NTM Services      |    |           |
+---------------+    +-----------+-----------+    |   Data    |
| NTM Services  |                |                |           |
+-------+-------+                |                |  File(s)  |
        |       +----------------+                |           |
        |       |           +---------------------+           |
        |       |           |                     +--+-----+--+
+-------+-------+---------+ |                        |     |
|       NTM Services      | |        +---------------+     |
+-------------------------+ | +------+------+              |
|        UI Monitor       | | |    Batch    |          +---+
+-----------+-------------+ | | Application |          |
|   Form    |  Internal   +-+ +-------------+          |
| Processor | Application |   | Stand-alone |   +------+------+
|           +-------------+   |    Form     |   |    Batch    |
|                         |   |  Processor  |   | Application |
+-------------------------+   +-------------+   +-------------+
```

Figure 3-1 Interface Block Diagram

3.1.1.2 Detailed Interface Definition

Internal forms-based applications interface with the Form Processor (FP) through the callable FP routines. Remote forms-based applications interface with the FP through the Application Interface (AI) routines which in turn use the Network Transaction Manager (NTM) services to communicate with the User Interface Monitor (UIM) which then invokes the callable FP routines on behalf of the the application. Batch forms-based applications interface with the FP through the callable stand-alone FP routines.

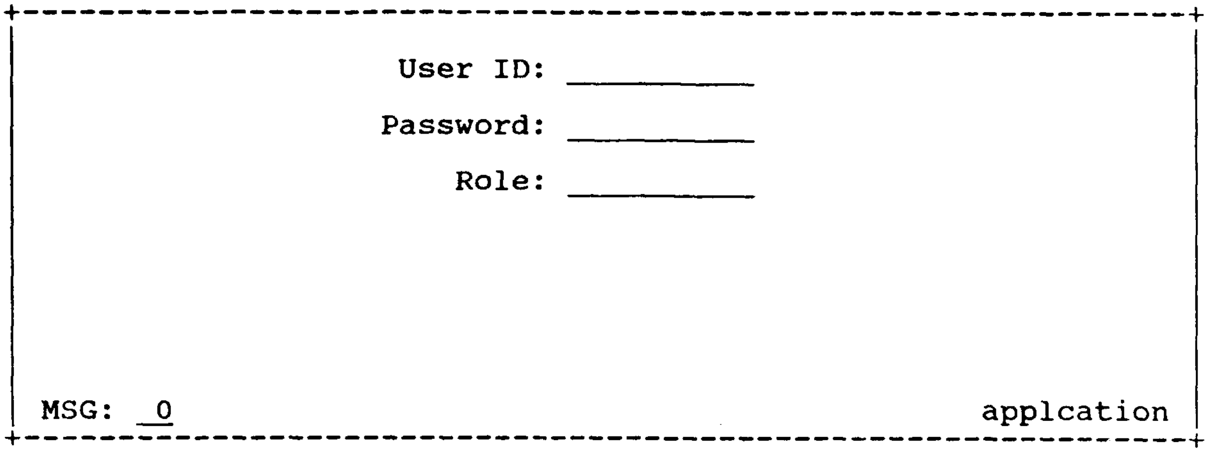
Each of the applications also interfaces with other components of the IISS through data files which are read and/or written by the applications. These data files are discussed in more detail in the Detailed Functional Requirements of each service and in Section 3.5.

3.2 Detailed Functional Requirements

The following subsections pre.ent the detailed functional requirements of each of the UI Services.

3.2.1 Access Control

The Access Control Service is implemeted as an internal application which is automatically invoked by the UI Monitor when a connection request is received from a new Virtual Terminal Device Driver to display the following screen:

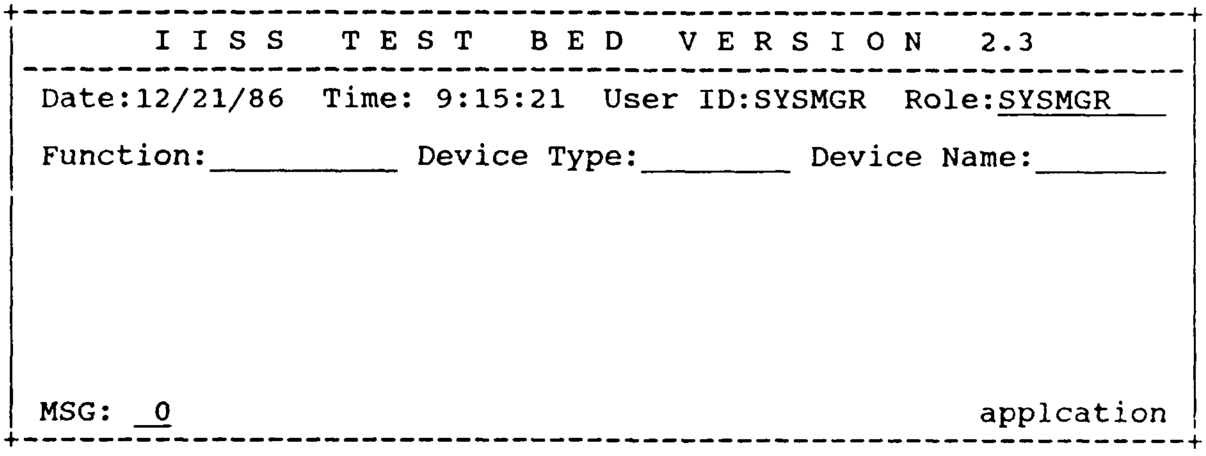


```
+------------------------------------------------------------+
|                                                            |
|                     User ID: ________                      |
|                                                            |
|                    Password: ________                      |
|                                                            |
|                        Role: ________                      |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
| MSG: _0                                         applcation |
+------------------------------------------------------------+
```

Once the screen has been filled in by the user, Access Control interrogates the UI Database to insure that the specified User ID exists, that the specified password is correct, and that the specified role is valid. If any of these integrity checks are not satisfied, an appropriate error message is issued and the user is given an opportunity to correct the information. If correct information is not entered by the fifth try, the user is disconnected from the IISS system. When correct information is entered, control is passed to the Function Invocation Service.

3.2.2 Function Invocation

The Function Invocation Service is implemented as an internal application which is automatically invoked after Access Control has successfully completed and remains running until the user disconnects. It displays and processes the following IISS Function Screen:



```
+------------------------------------------------------------+
|        I I S S   T E S T   B E D   V E R S I O N   2.3     |
| ---------------------------------------------------------- |
| Date:12/21/86  Time: 9:15:21  User ID:SYSMGR  Role:SYSMGR  |
|                                                            |
| Function:_________ Device Type:_______ Device Name:_______ |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
| MSG: _0                                         applcation |
+------------------------------------------------------------+
```

When the screen is entered by the user, Function Invocation interrogates the UI Database to determine which function has been selected. This step is required since the user does not have to enter the complete function name, just a unique prefix. If the entered function is not a prefix of any valid function or is a prefix of more than one valid function, an appropriate error message is issued and the user is given an opportunity to correct it. Valid functions are those which are authorized for the user's current role or the role "*" which is a wildcard and matches any role.

The selected function's definition is then retrieved from the UI Database. If a parameter form is currently displayed which is not the correct parameter form for the selected function, the existing parameter form is removed. If the function requires a parameter form which is not currently displayed, the form is displayed in the lower portion of the Function Screen and the user is given an opportunity to fill it in.

Once the correct parameter form (if any) has been displayed and filled in, the application type is examined to determine whether it is an internal or remote application. If it is an internal application, the Device Type and Device Name fields are ignored and the application is called as a subroutine.

If the selected function is a remote application, the Device Type and Device Name fields are used to initiate a new Virtual Terminal Device Driver for the selected device. The function's definition contains the name of the application associated with the function and a message to be sent to it. The application is started by sending the message using the NTM ISEND Service.

3.2.3 Exit

The Exit Service is implemented as an internal application (EXIT) which is invoked by Function Invocation (usually through the standard function "EXIT"). It is also invoked when the <QUIT> key is pressed on the IISS Function Screen. It aborts any currently running applications and disconnects the user from IISS.

3.2.4 Function Screen Help

The Function Screen Help Service is implemeted as an internal application (HELP) which is invoked by Function Invocation (usually through the standard function "HELP"). It is also invoked by pressing the <HELP> key on the IISS Function Screen. If it is invoked by the <HELP> key and the Function field is not blank, it searches the UI Database for the function and displays its description or an error message if a valid function cannot be found. Otherwise, it displays a list of all the valid functions and their descriptions as shown below.

```
+---------------------------------------------------------------+
|     I I S S   T E S T   B E D   V E R S I O N   2.3          |
|---------------------------------------------------------------|
| Date:12/21/86  Time: 9:15:29  User ID:SYSMGR  Role:SYSMGR___  |
|                                                               |
| Function:_________ Device Type:________ Device Name:_______   |
| SYSGEN      - User Interface System Generation Utility        |
| APPGENER    - Application Generator                           |
| ARTEST      - Form Processor Test Application                 |
| EXIT        - Exit from IISS                                  |
| FDFE        - Form Editor                                     |
| FLAN        - Forms Language Compiler                         |
| HELP        - Function Screen Help                            |
| MM          - Message Management                              |
| PASSWORD    - Change Password Utility                         |
| TE          - Text Editor                                     |
| MSG: _1 Use scrolling and paging keys           applcation    |
+---------------------------------------------------------------+
```

3.2.5 Change Password

The Change Password Service is implemented as an internal application (PASSWORD) which is invoked by Function Invocation (usually through the standard function "PASSWORD"). The definition of the invoking function requires the following parameter screen to be displayed (note that the password fields are non-display):

```
+---------------------------------------------------------------+
|     I I S S   T E S T   B E D   V E R S I O N   2.3          |
|---------------------------------------------------------------|
| Date:12/21/86  Time: 9:15:21  User ID:SYSMGR  Role:SYSMGR___  |
|                                                               |
| Function:password_ Device Type:________ Device Name:_______   |
|                                                               |
| Old Password        New Password        Verification          |
|                                                               |
| __________          __________          __________            |
|                                                               |
|                                                               |
|                                                               |
|                                                               |
| MSG: _0                                         applcation    |
+---------------------------------------------------------------+
```

Once the parameter form is filled in and the Change Password application invoked, it verifies that the old password matches the user's password in the UI Database and that the new password matches the verification. If either of these integrity checks is not satisfied, an appropriate error message is displayed. Otherwise, the UI Database is updated with the new password.

3.2.6 System Generation

The System Generation Service is composed of four applications: SYSGEN allows for the creation and modification of the UI Database, UDBEXP dumps the UI Database into an ordinary sequential file which can be move from system to system, UDBIMP recreates the UI Database from a dump file, and UDBCNV which dumps an old-style Oracle UI Database. Each of these applications is discussed in detail in the following sections.

3.2.6.1 SYSGEN

SYSGEN is a remote application (SDSYSGENZZ) which provides for the creation and maintenance of the UI Database. When invoked from Function Invocation (or run as a batch application) the following initial screen is displayed.

```
+----------------------------------------------------------------------+
|            User Interface System Generation Utility                  |
|            ----------------------------------------                  |
|                                                                      |
| Display Selection Keys                   Data Manipulation Keys      |
| ----------------------                   ----------------------      |
| <PF5>  - Display User Information   <ENTER> - Insert / Update        |
| <PF6>  - Display Role Information   <PF12>  - Delete                 |
| <PF7>  - Display Function Information                                |
| <QUIT> - Return to this screen / Exit                                |
|                                                                      |
|                                                                      |
|                                                                      |
|                                                                      |
|                                                                      |
| MSG:  0                                               applcation     |
+----------------------------------------------------------------------+
```

The Display Selection Keys (<PF5> [<USER>], <PF6> [<ROLE>], and <PF7> [<FUNCTION>]) are used to select the information to be displayed. Once information is displayed, the Data Manipulation Keys (<ENTER> [<UPDATE>] and <PF12> [<DELETE>]) are used to manipulate the displayed data.

The Display Selection Keys cause information of the specified type to be displayed. If the cursor is positioned on the name of a user, role, or function when the key is pressed, the user, role, or function will be used to limit the information displayed to that which is related to the selected user, role, or function. Otherwise, a listing of all available information of the type selected will be displayed.

For example, when the cursor is not on the name of a user, role, or function (such as from the main screen), the <USER> key displays a list of all authorized users, <ROLE> displays a list of all authorized roles, and <FUNCTION> displays a list of all authorized functions. If the cursor is placed on the name of a user and the <USER> key pressed, detailed information about the user is displayed. If the cursor is placed on the name of a role and the <USER> key pressed, a list of all users authorized to use that role is displayed.

Unless otherwise specified in the following screen descriptions, the <USER> key displays a list of all users, <ROLE> displays a list of all roles, <FUNCTION> displays a list of all functions, <QUIT> returns to the initial screen, and the Data Manipulation Keys have no effect. On the initial screen, <QUIT> exits from the application.

The list of all authorized users appears as follows:

```
+-----------------------------------------------------------------+
| Users (use scroll/page keys to see more)                        |
|                                                                 |
| __________   -                                                  |
| MORENC       - Test User                                        |
| SYSMGR       - System Manager                                   |
| TESTUSER     - unit test plan test user                         |
|                                                                 |
|                                                                 |
|                                                                 |
|                                                                 |
|                                                                 |
|                                                                 |
|                                                                 |
| MSG: _0                                            applcation  |
+-----------------------------------------------------------------+
```

The list is scrollable and the initial input field can be used to select a user by entering the username rather than scrolling through the list. This is required when adding a new user since the new user's username does not appear in the list of current users. Placing the cursor on a username and pressing <USER> displays the user definition screen.

The list of all roles appears as follows:

```
+-----------------------------------------------------------------+
| Roles (use scroll/page keys to see more)                        |
|                                                                 |
| __________                                                      |
| *            (No users)                                         |
| MANAGER      (No functions)                                     |
| SYSMGR                                                          |
| TESTROLE1                                                       |
| TESTROLE2                                                       |
| TESTROLE3                                                       |
|                                                                 |
|                                                                 |
|                                                                 |
|                                                                 |
| MSG:  0                                            applcation  |
+-----------------------------------------------------------------+
```

The list is scrollable and the initial input field can be used to select a role by entering it rather than scrolling through the list. This is required when adding a new role from this screen since the new role does not appear in the list of current roles. When the cursor is placed on a role, pressing <USER> displays the users authorized for the role and <FUNCTION> displays the functions authorized for the role.

The list of all functions appears as follows:

```
+-----------------------------------------------------------+
| Functions (use scroll/page keys to see more)              |
| ________  _                                               |
| APPGENER   - Application Generator                        |
| ARTEST     - Form Processor Test Application              |
| EXIT       - Exit from IISS                               |
| FDFE       - Form Editor                                  |
| FLAN       - Forms Language Compiler                      |
| HELP       - Function Screen Help                         |
| MM         - Message Management                           |
| PASSWORD   - Change Password Utility                      |
| SYSGEN     - User Interface System Generation Utility     |
| TE         - Text Editor                                  |
| TESTFUNC   - unit test plan test function                 |
| MSG: _0                                        applcation |
+-----------------------------------------------------------+
```

The list is scrollable and the initial input field can be used to select a function by entering its name rather than scrolling through the list. This is required when adding a new function since the new function does not appear in the list of current function. Placing the cursor on a function and pressing <FUNCTION> displays the function definition screen.

The user definition screen appears as follows:

```
+-----------------------------------------------------------+
| User ID  User Name                  Password Verification |
| TESTUSER unit test plan test user   ________ ________     |
|                                                           |
| User Form File Template                                   |
| user$disk:[home]%s.fd____________________________________ |
|                                                           |
| User Source File Template                                 |
| user$disk:[home]%s.fdl___________________________________ |
|                                                           |
| Authorized Roles (use scroll/page keys to see more)       |
|                                                           |
| __________                                                |
| TESTROLE1                                                 |
| TESTROLE2                                                 |
| TESTROLE3                                                 |
| MSG: _0                                        applcation |
+-----------------------------------------------------------+
```

When the cursor is not positioned in one of the authorized roles, the Data Manipulation Keys insert, update, or delete the user. When the cursor is positioned in one of the authorized roles, the Data Manipulation Keys insert or delete roles from the user and the <USER> and <FUNCTION> keys display the users and functions authorized for the role.

The function definition screen appears as follows:

```
+-------------------------------------------------------------+
| Function Description                                        |
| TESTFUNC unit test plan test function                       |
|          ____________________________________________       |
|                                                             |
| Parameter Form      AP Name         AP Type                 |
| TESTPARM            SDTESTAPZZ         R                    |
| __________          __________         _                    |
|                                                             |
| AP Message (scroll for more)                                |
| Sample message to be sent to start an AP                    |
| ____________________________________________________________|
| ____________________________________________________________|
| ____________________________________________________________|
|                                                             |
| Authorized Roles (use scroll/page keys to see more)         |
|                                                             |
| __________                                                  |
| TESTROLE1                                                   |
| TESTROLE2                                                   |
| TESTROLE3                                                   |
| MSG: _0                                          applcation |
+-------------------------------------------------------------+
```

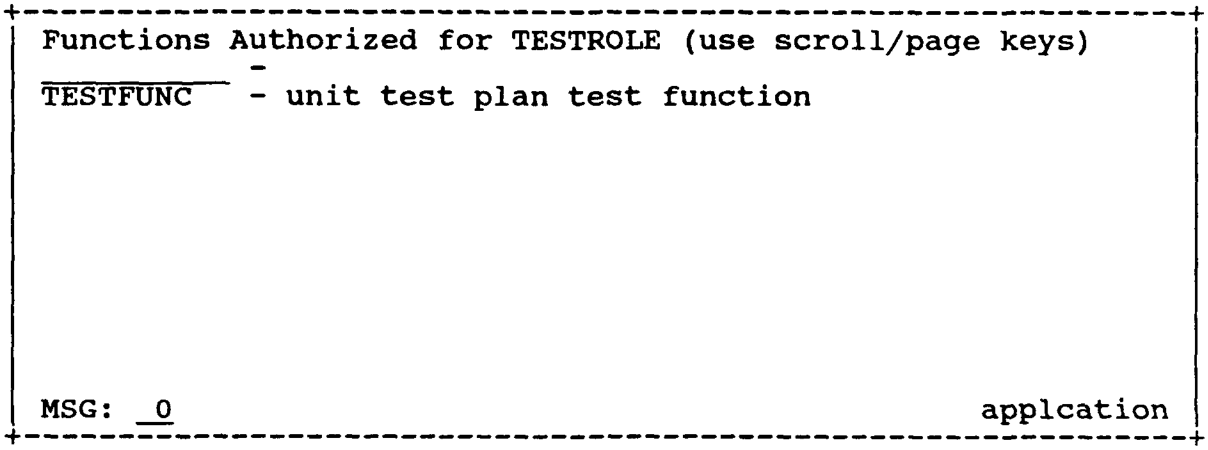
When the cursor is not positioned in one of the authorized roles, the Data Manipulation Keys insert, update, or delete the function. When the cursor is positioned in one of the authorized roles, the Data Manipulation Keys insert and delete roles from the function and the <USER> and <FUNCTION> keys display the users and functions authorized for the role.

The list of users for a role is very similar to the list of all users and appears as follows:

```
+-------------------------------------------------------------+
| Users Authorized for Role TESTROLE  (use scroll/page keys)  |
|                                                             |
| __________ -                                                |
| TESTUSER   - unit test plan test user                       |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
| MSG: _0                                          applcation |
+-------------------------------------------------------------+
```

The list is scrollable and the initial input field can be used to select a user by entering the username rather than scrolling through the list. This is required when adding a new user since the new user's username does not appear in the list of current users. When the cursor is positioned on a username, the Data Manipulation Keys insert and delete users and pressing <USER> displays the user definition screen.

The list of functions for a role is very similar to the list of all functions and appears as follows:



```
+------------------------------------------------------------+
| Functions Authorized for TESTROLE (use scroll/page keys)   |
|                                                            |
| TESTFUNC  - unit test plan test function                   |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
|                                                            |
| MSG: 0                                         applcation  |
+------------------------------------------------------------+
```

The list is scrollable and the initial input field can be used to select a function by entering the function name rather than scrolling through the list. This is required when adding a new function since the new function does not appear in the list of current function. When the cursor is positioned on a function, the Data Manipulation Keys insert and delete the function from the role and pressing <FUNCTION> displays the function definition screen.

3.2.6.2 UDBEXP

UDBEXP is a batch application which dumps the UI Database into an ordinary sequential file (UIDUMP.DAT). It should be run only when the IISS system is shut down. The sequential file can be transported to other nodes in the IISS system, but UDBEXP does not itself provide any mechanisms for accomplishing this. In particular, it does not provide character set conversion, protocol conversion, or file transport services.

3.2.6.3 UDBIMP

UDBIMP is a batch application which recreates the UI Database from a dump file such as that produced by UDBEXP or UDBCNV. It should be run only when the IISS system is shut down. The sequential file may have been transported from other nodes in the IISS system, but UDBIMP does not itself provide any mechanisms for accomplishing this. In particular, it does not provide character set conversion, protocol conversion, or file transport services.

3.2.6.4 UDBCNV

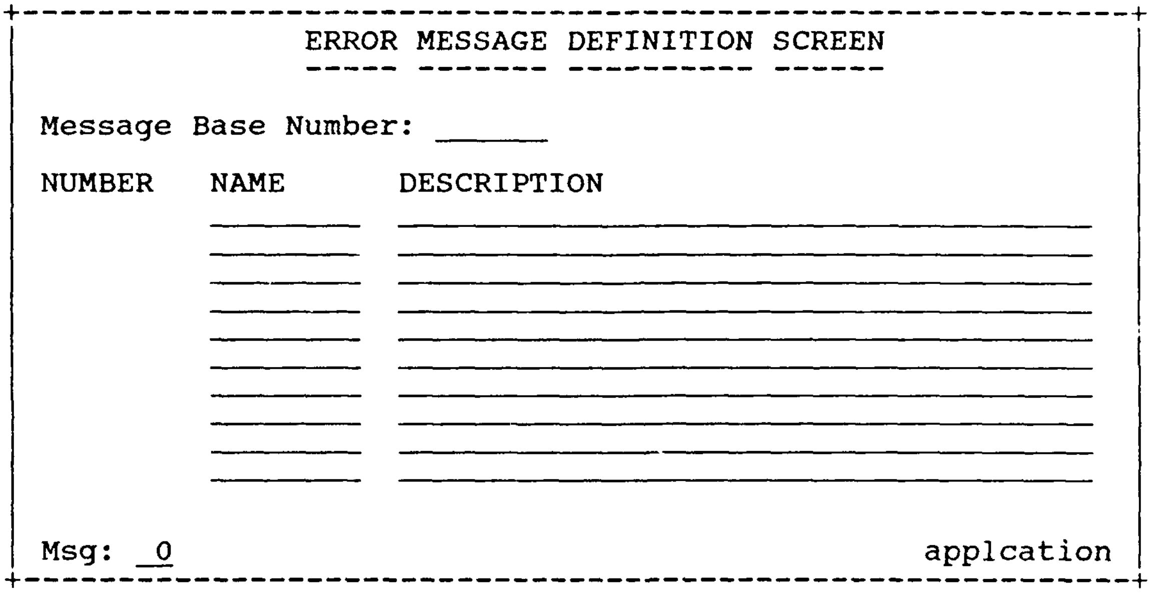
UDBCNV is a batch application which dumps an old-style (IISS Release 2.2 and earlier) Oracle UI Database into a sequential file similar to UDBEXP. The sequential file may then be imported with UDBIMP to convert the old-style database to the current format. The conversion process is intended to preserve all existing data, but the application type in function definitions is forced to be "remote". This is necessary since previous versions ignored this entry and treated all applications as remote, while the current version honors it.

3.2.7 Message Management

The Message Management Service is composed of two applications: MM allows for the creation and maintenance of message files and INCGEN creates include files relating message names and numbers for use in application program. Each of these applications is discussed in detail in the following sections.

3.2.7.1 MM

MM is a remote application (SDMMZZZZZ) which creates and maintains message files to be used in conjunction with the Form Processor routine "PMSGLC". When invoked from Function Invocation (or run as a batch application) the following screen is displayed:



```
              ERROR MESSAGE DEFINITION SCREEN
              ----- ------- ---------- ------

 Message Base Number: ______

 NUMBER    NAME      DESCRIPTION
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________
           ________  _____________________________________

 Msg: _0                                          applcation
```

A group of 100 message numbers is selected by entering a Message Base Number (only the first three digits are significant) and pressing <ENTER> which causes the message numbers to be filled in. If a message file exists for the selected range of error numbers, the message names and descriptions are filled in as well.

Changes and additions are made directly on the screen. The <PF5> and <PF6> keys are used to scroll up and down through the messages in groups of 10. <PF7> and <PF8> go directly to the first and last group of messages. <ENTER> is used to save changes which have been made back into the message file.

By convention, deleted messages are indicated by a blank message name field. Although this does not recover the space used by the message in the message file, it does indicate that the number is available for reassignment. Also, other utilities which process message files interpret this convention and skip the deleted messages.

It is possible to change to a different file at any time by changing the base number, but this does not save any changes which have been made -- the <ENTER> key must be used first.

A typical completed screen appears as follows:

```
+------------------------------------------------------------------+
|                 ERROR MESSAGE DEFINITION SCREEN                  |
|                 ----- ------- ---------- ------                  |
|                                                                  |
|  Message Base Number: 850__                                      |
|                                                                  |
| NUMBER    NAME        DESCRIPTION                                |
| 85000     INVPOS___   INVALID POSITION_______________________    |
| 85001     IMPSEQ___   IMPROPER SEQUENCE______________________    |
| 85002     SYNERR___   SYNTAX ERROR___________________________    |
| 85003     NVALCOM__   NOT A VALID COMMAND____________________    |
| 85004     DUPFLD___   DUPLICATE FIELD ENTRY,TRY AGAIN________    |
| 85005     INVROW___   INVALID ROW____________________________    |
| 85006     _________   _______________________________________    |
| 85007     _________   _______________________________________    |
| 85008     _________   _______________________________________    |
| 85009     _________   _______________________________________    |
|                                                                  |
| Msg:  _1  Changes saved                              applcation  |
+------------------------------------------------------------------+
```

3.2.7.2 INCGEN

INCGEN is a batch application which creates include files relating message names and numbers for use in application programs. When run, it prompts for the programming language the include file is to be generated for (C, COBOL, FORTRAN, or PL/I), the name of the file to be generated, and the name(s) of message files to process. The application is exited by entering an End-of-File indication in response to the prompt for an input file name.

3.3 Special Requirements

3.3.1 Programming Methods

The UI Services are programmed using structured design and coding techniques. Basic programming standards for readability and ease of debugging are followed. The UI Services are implemented using the Rapid Application Generator and the C and COBOL programming languages to insure portability of the FP code with minimum effort.

3.3.2 Expandability

To allow for flexibility and extensibility, the UI Database should be defined to the Common Data Model (CDM) and accessed via the Neutral Data Manipulation Language rather than being accessed directly. This release, however, does access the database directly for performance reasons.

The difficulty of adding additional UI Services depends on the type of service to be added. Remote applications may be easily added as these are ordinary IISS application programs. Likewise, batch applications are easily added. Adding internal applications requires coding changes to the Form Processor, the difficulty of which depends on the complexity of the application. It is recommended only for very simple applications.

3.4 Human Performance

Many of the UI Services are forms-driven. Consideration was given to using menu-selection entry such as is used on many small computer systems available today. This approach was rejected in favor of entering the application name due to the large number of applications which might exist. Cursoring through such a large list would take an unreasonable amount of time. (However, this would be a desirable extension to the Function Screen help facility.) A hierarchy of menus was considered to be unwieldy and time-consuming for the current implementation, but would be a reasonable extension for the future.

3.5 Data Base Requirements

3.5.1 User Interface Database

The UI Database is accessed by a number of the UI Services. The format of this database is specified in the Form Processor Development Specification [10].

3.5.2 Message Files

Message files are access by the Message Management Service. The format of these files is also specified in the Form Processor Development Specification.

SECTION 4

QUALITY ASSURANCE PROVISIONS

4.1 Introduction and Definition

"Testing" is a systematic process that may be preplanned and explicitly stated. Test techniques and procedures may be defined in advance and a sequence of test steps may be specified. "Debugging" is the process of isolation and correction of the cause of an error.

"Antibugging" is defined as the philosophy of writing programs in such a way as to make bugs less likely to occur and when they do occur, to make them more noticeable to the programmer and the user. In other words, as much error checking as is practical and possible in each routine should be performed. This approach was followed in the development of the UI Services.

4.2 Computer Programming Test and Evaluation

The quality assurance provisions for test consist of the normal testing techniques that are accomplished during the construction process. They consist of design and code walk-throughs, unit testing, and integration testing. These tests are performed by the design team. Structured design, design walk-through and the incorporation of "antibugging" facilitate this testing by exposing and addressing problem areas before they become coded "bugs".

The integration testing entails use of the UI Services on the VAX under VMS and the IBM under MVS. Each application is tested separately. All testing is done on the IISS Test Bed VAX and IBM machines.

SECTION 5

PREPARATION FOR DELIVERY

The implementation site for the constructed software is the Integrated Information Support System (IISS) Test Bed site. The software associated with each User Interface CPCI release is delivered on a media which is compatible with the IISS Test Bed. The release is clearly identified and includes instructions on procedures to be followed for installation of the release.

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